

Looking Ahead: Trends that Will Shape Cyberlearning

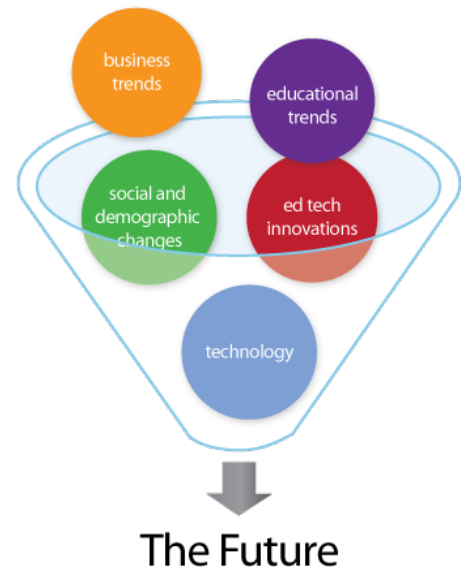
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Questions, or want to add to this topic or a new topic? [Contact CIRCL](#).

Latest update: Added [2016 Internet Trends Report](#) (6/21/16)

Overview – Five Kinds of Trends to Watch

The ambition of cyberlearning research is to have a broad and profound impact on the products and methodologies used by learners and adults who support their learning (including teachers, coaches, mentors, etc.). To increase the relevance of our work, innovators should try to understand how learning is changing, which changes will have enduring importance, and what kind of adoption timeframes they should anticipate. Technology is not the only driver of change in learning. This primer paints a broad-brush picture of the landscape at this moment. The Resources section suggests some of places to find up-to-date coverage of trends and issues, such as the [NMC Horizon Reports](#).



This primer organizes two dozen current trends that we feel are most relevant into five categories: **social and demographic changes**, **general technology developments**, **innovations in educational technology**, **changes in the way we teach**, and **business trends**. While we focus on the United States, other markets are experiencing similar changes. Where possible, we've tried to suggest some of the implications for cyberlearning research.

The Trends

Social and demographic changes

Education systems respond to social needs. Looking back at the design of school in the early 1900s, for example, the goal was to transform rural and immigrant children into literate factory workers. It's easy to

point to ways that our system is already out of date, but society continues to evolve in ways that will change its demands on the education system.

Skill needs and national economic policy. Today's intense efforts to find innovative solutions to STEM education reflects the importance of changing workforce needs in a global economy driven by technology. Today it's computer programming, next year it may be an intense effort to improve the way we teach foreign languages to youngsters. Many jobs require high-levels of preparation and continuous learning. There is a general belief that in the post-industrial age, our country's economic well-being is linked to the ability of our citizens to think, create, and innovate using the affordances of technology. In addition to the 3Rs, and traditional employability skills, workers need new types of skills to innovate and solve problems, including techniques to support complex communication, collaboration, computational thinking, intergenerational workplaces, and the ability to use and customize the technology-enabled tools and information resources.

Demands of today's learner. Rapid advances and the ubiquity of technology have altered the ways today's learners learn. Trends like rising digital literacy benchmarks, anywhere/anytime learning, digital entertainment, and the emergence of a new culture of power users of technology, have resulted in a generation of learners who expect high-fidelity interactions, require more control over their learning environments, and demand the ability to adapt their technologies to their own purposes.

Part-time learners. We're seeing a dramatic rise in the number of students who opt out of full-time schooling because they can't afford full-time, because they're busy with a job and/or a family, or because they just don't want to be a full-time student. For example, economic realities and questions about the value of a 4-year residential experience have created a growing population of higher-ed students who opt for part-time.

Independent learners. There is a growing segment of learners who are not associated with an educational institution or who are linked part-time to several providers. They may, for example, be working toward certification in a particular job-related skill or attending individual courses from a school or an online provider.

Disappearing middle class students. After the second world war in the US, the GI bill opened the 4-year residential college experience to the masses. Education in turn allowed people to move into middle class,

professional jobs. Today, it is no longer certain that college, or society, will offer that kind of upward social mobility in the future. Furthermore, the cost of college creates hardship for the middle class because income guidelines prevent middle class families from qualifying for financial aid. Many students today, even those with professional, post-graduate degrees, leave school heavily in debt from college loans and then have difficulty finding work in chosen career fields. The consequences ripple through the economy: loan defaults; delay in starting a family and owning a home; underemployment; lower tax revenues; and so on.

Gender and racial diversity. As the student population changes, the fact that major gaps in the educational achievement of women and racial minorities still exist, and in fact are growing, will become more salient. Recognizing that diversity sparks creativity and innovation, new industry/education partnerships addressing this issue will continue to emerge.

General technology developments

Moore's law, Internet, mobile, cloud, ubiquity. The amount of computing power that is always available, everywhere, to every teacher and every learner, will continue the rapid rise driven by Moore's law, the Internet, mobile computing, cloud computing, wearable computing, Bring Your Own Device, and so on. The Internet of Things will allow lab instruments, peripheral devices, tools, sensors, and appliances to be monitored and controlled by the computing devices we carry and wear.

Increasingly "natural" human-computer interaction. As research advances in neuroscience and computer science, human/computer interaction will become seamless. Technologies like speech understanding, facial affect recognition, gesture analysis, avatars, and human-like robots will result in more human-like interaction with learning activities (and with computing generally). Robots and avatars that can speak, listen, understand gestures, and read facial expressions and body language will relate to learners in qualitatively different ways. Advances in assistive technologies have the potential, for example, of drawing more disabled learners into the mainstream of education and work.

Artificial intelligence. Whether they walk, roll, or fly, drones, avatars, and robots that can see, hear, and respond intelligently are on the horizon. AI technologies allow computer systems to understand what they see and hear and to communicate with people and with each other. They can see invisible patterns in vast amounts of data, demonstrate logical reasoning, and never forget a face or a fact. These systems are smart and getting smarter. Continued research and more powerful computing devices will make human-like interaction and intelligent responses as essential in future computer products as color screens are today.

Big data and analytics. A related area of computer science that will continue to advance rapidly and change our expectations about the products we use is the ability to find patterns in the increasingly large amounts of data that are generated during our use of computer systems. This technology allows computer systems to learn things about us based on the data trails we leave during our online activities. Patterns in the behavior of online students, for example, are already being used to flag students who are likely to drop a course unless a teacher intervenes. Caveats about the use of big data abound, however. See, for example, [Why Machines Discriminate — and How to Fix Them](#), an interview with Kate Crawford and Suresh Venkatasubramanian.

Immersive environments. The contexts in which we interact with computer programs will change. Virtual reality, virtual laboratories, and simulated practice environments will become more commonplace. Elements of game technology will continue to be used to increase motivation. Augmented reality — the ability to superimpose relevant, computer-generated information (visual, auditory, haptic) via devices like Google Glass or the Apple iWatch, along with advances in speech-based interaction, will continue to make computing systems more useful in every aspect of our lives. In enterprise training, the use of augmented reality on the job is already blurring the distinction between training and just-in-time performance support.

Video. Video has become a major part of how we all use our devices — and part of how we learn. In our day-to-day lives, YouTube is the first place one looks for lessons about how to fix a dishwasher or tune a guitar. In education, video-based innovations include lecture capture, the Khan Academy, and MOOCs. With video, learners have the opportunity to start watching when convenient, stop in the middle, resume any time, and backup to catch something that went by too fast. If the student population becomes increasingly accustomed to getting its information as video, then pedagogy, curricula, and tools will have to adjust.

3D printing. Fabrication in the real world of anything that can be designed on a computer offers fascinating opportunities for manufacturing, construction, and even art. Often a part of the Makers Movement in education, 3D printing technology motivates learners of all ages to think about design and learn to use modeling tools; to create and innovate by translating their concepts/ideas into concrete objects.

Social computing – learner designed learning environments. Much of our online-time is spent interacting with other people, forming along the way new kinds of social structures, large and small. The

online networks that we are all building, maintaining, and using every day for work and play will continue to redefine learning environments, change the teacher-student and teacher-parent dynamics, expose teachers and students to new ideas and new products, and empower individuals and groups to take action and make changes.

Public Awareness and Market Adoption of Educational Technology

Researchers and product developers are exploring every possible way that advances in computer technology might improve teaching and learning. Here are some of the key trends in innovation that are broadly considered of commercial interest circa early 2016, when this primer was written. (The Resources section will be kept up-to-date with more current discussions.) Please note that broadly discussed educational trends and “cyberlearning themes” do not necessarily exactly align; the market is influenced as much by general industry developments and the situation in the schools as it is by learning sciences research.

Learning analytics, data-driven design, personalization. The ability to extract meaningful information about students, teams, schools, and learning materials from large bodies of data collected online will change the way schools and teachers make decisions about administration, teaching, and procurement. New products will analyze the data and help teachers use it effectively in the classroom. Adaptive teaching materials will use the data to personalize the learners experience.

Teacher’s dashboard, email, social networking. Teachers, learners, and parents will be more connected, more responsive, and more informed.

Data privacy, student data lockers. Good administrative and instructional decisions require data about learners and their past activities. The need for data access is even more acute for AI-enhanced tools like Intelligent Tutoring Systems, since their power comes from making inferences based on data about the student’s knowledge and history. There is a natural conflict between the need to share data across systems vs. the need to protect learners from inappropriate access to their data. One proposed solutions is the personal data locker — a private, online data store administered by learners (and their parents), who then can grant appropriate access to teachers, educational institutions, and publishers. Institutions and jurisdictions that solve this problem will have overcome a major barrier in advancing their use of educational technology.

Adaptive learning materials, immersive practice, and stealth assessments. Using data about students background, knowledge, and recent performance, many products now offer learning experiences that are personalized and that adapt to the learner as she progresses through the material. Combining techniques from digital gaming, simulation, virtual reality, and augmented reality with stealth assessment and a deep model of the learner based on her past experience in multiple learning environments will make for much more effective digital learning products.

Badges, independent certification, and e-portfolios. Perhaps no other innovation has the potential to change the educational landscape at all levels than does independent certification and the use of “work done” portfolios instead of traditional transcripts in evaluating students’ progress and ability. Independent certification on specific job skills is already a major factor in hiring and advancement in the software industry and other tech sectors. Recently, a coalition of 80 colleges and universities, called the [Coalition for Access, Affordability and Success](#), proposed a new admissions framework based on an online platform for building a portfolio of the applicant’s work, starting in 9th grade.

Intelligent tutoring systems, robo-graders, personal learning assistants. Artificial intelligence research has promised for many years to offer each student the individualized attention of a personal tutor. Some products based on this research are already available, demonstrating not only subject-matter expertise, but also teaching skills that have been distilled from expert tutors. As AI has demonstrated in other applications (Siri, face recognition, self-driving cars) the early products may not seem so smart, but they learn fast.

Ebooks for education. Just as has happened with publishing in general, the use of tablet computers as a major platform for the delivery of educational materials is an inevitability. Educational publishers, following the publishing industry trend, have embraced the idea of delivering textbooks and other educational materials digitally. But their vision of the ebook started from the paper books they already create — plus some nice, tablet-enabled features like portability, search for keywords, embedded video, and interactive graphics. Eventually, when every student’s schoolwork is tablet based, the marketplace will abandon the idea of the book altogether. How will authors and publishers create new products that make use of a hand-held, mobile, Internet-enabled computer with tons of embedded technology (GPS, camera, mic, motion, orientation, touch, gesture, wifi, bluetooth) to advance the state of education and training? The educational publishing industry is being disrupted, and every aspect of the relationships among publishers, institutions, teachers, and students is subject to change.

Pedagogical Trends

Several forces are driving change in the way we teach:

- What we teach — what the learners need to know — is changing. Beyond politically sensitive issues like evolution or global warming, there are serious questions about what students need to know to earn a living and take part in social discourse. Their educational needs are also shaped by the fact that they will likely be connected to the Internet every day for their entire lives.
- We have new insights into how people learn from research in psychology and neuroscience, and from studies of the efficacy of earlier innovations. See for example, CIRCL's [Primer on Learning Sciences](#).
- As teachers and students acquire and work with technology, they invent new techniques and approaches that are enabled by the technology itself.

Cyberlearning researchers are familiar with a wide range of new pedagogical approaches: flipped classrooms, experiential learning, collaborative learning, competency-based education, and so on. The recently released [Innovating Pedagogy 2015](#) report from the Open University and SRI Education reviews a dozen new ideas about how we teach. While some approaches, like flipped classrooms, have seen relatively broad adoption and classroom experimentation, most are not in everyday use. We may find ourselves, over the next decade, in an extended period of experimentation by educators, trying different approaches to teaching using new products that support these innovations.

Business trends

From the business perspective, there are obvious shifts in how education will be conducted. From for-profit and charter schools to online offerings like Khan Academy and Coursera, the fundamentals of the education business are changing. The following trends are worth watching.

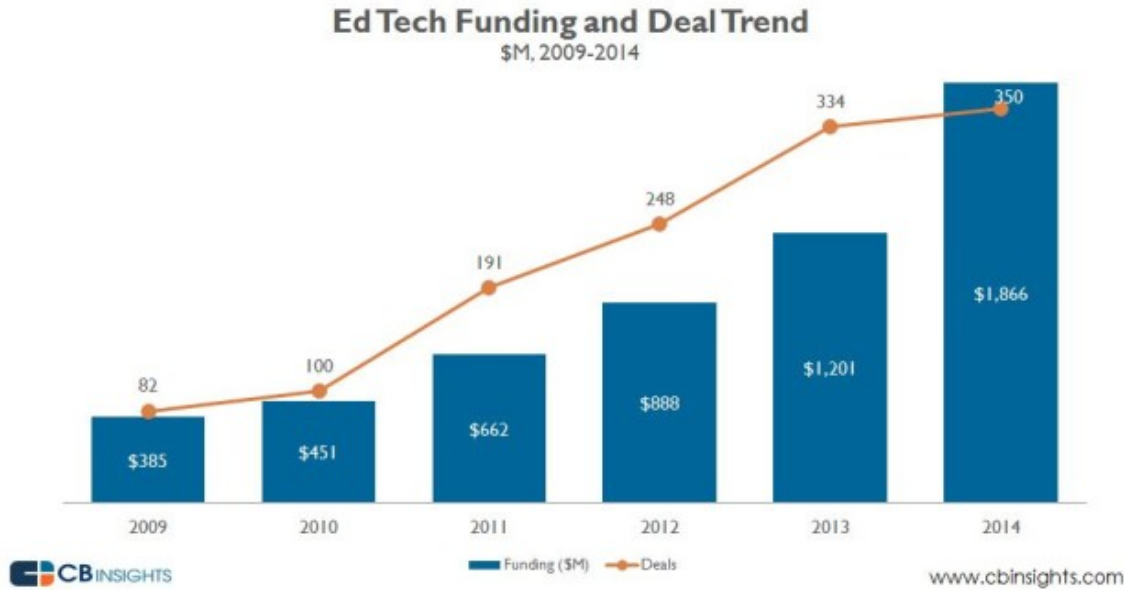
New procurement models, aggregators, OER. Teachers can find learning materials and tools of all types online, disrupting the publisher-district supply chain for textbooks and other content. Teacher communities allow members to review and recommend materials. Schools are experimenting with new ways of working with publishers — e.g. buying just one chapter of a textbook. The trend is for more materials and a wider variety of materials to be available from publishers and from other sources (government agencies, non-profits, teacher-entrepreneurs). Aggregators, à la Netflix or Amazon, could

offer not only large catalogs, but also reviews and recommendations. In 2015, according to [Inside Higher Ed](#), some college textbooks for advanced courses now cost upwards of \$400. In education there may be a much larger presence than in other industries of freely shared Open Educational Resources and open source software.

Platforms and data sharing. Some publishers and technology vendors are introducing tablet- or PC-based “platforms” for managing learning in schools and classrooms, and some are opening their platform to third party content. In addition the major publishers’ platforms include data frameworks that allow all of their course materials to store and share student data securely in one place. While this trend may lead, in the short term, to proprietary school-wide or district-wide solutions, educators will likely find that multi-vendor solutions have advantages. As students and teachers become more sophisticated in their use of technology, they will want to incorporate best-of-breed products in different categories and not be “locked-in” to one vendor. The evolution of the school ecosystem will shape the commercial introduction of products incorporating new functionality like learning analytics, affect recognition, and adaptive testing.

Disruption. Almost every aspect of education is experiencing business pressure. Decreased demand for 4-year residential programs might cause an increase in college closures. Fewer students and increased use of MOOC-like technology in the large undergraduate courses may reduce the number of faculty jobs available for new PhD’s. For-profit schools will, at least in the short term, continue to expand in some educational markets. Will traditional publishers make the leap to digital, or will K12 content be produced by companies like Disney or by new firms among the hundreds of ed tech startups? As the role of community colleges continues to focus on preparing people for jobs, will they build closer relationships with local employers?

Investment trends. According to [EdTech Digest](#), venture investment in ed tech companies was below \$200M per year from 2000 through 2008, and then things changed. This graph below from CB Insights via [Geekwire](#), shows a compound annual growth rate of 30% per year from 2009 through 2014. Of course, venture funding is a boom and bust phenomenon — there’s always a new, promising investment area to focus on. Continued investment of new ed tech companies and products depends in large part on the success of the early entrants.



Systems integration, learning engineering, and interoperability standards. Every educational situation is different. Innovative administrators rely on systems engineers to put together solutions that will work for their institution or jurisdiction. These “learning engineers” must be familiar with the underlying learning science, but they must also know about all of the available products and tools; historical efforts that have worked in similar situations elsewhere (and why some didn’t work); relevant regulations; and the details of the already installed systems. We are just beginning to see the emergence of graduate programs to train this type of engineer (see, for example, [CMU’s Masters of Educational Technology and Applied Learning Science program](#).) These savvy ed tech “customers” often insist that the products they buy conform to software standards that allow solutions to be constructed from multiple vendors’ products.

Issues – The Long View

There are so many innovations, disruptions, and trends to track, it’s difficult to know which will impact what aspects of education and learning science research in the short term. In taking a longer view, however, some issues clearly warrant attention from cyberlearning researchers.

There are winds of change in education from charter preschools to the university-based MOOCs. Change creates opportunities for innovation and for new technology. The rapid advances in educational technology

have created products that offer educators and learners an ever broadening array of features and functionality. In fact, today's students, many of whom are power users of technology, increasingly demand that advanced computing and communications resources be available to facilitate their learning. But technology is not the only driver. Technology creates the possibilities; the market creates success. In the process, institutions, companies, business models, and whole industries can break apart and recombine. For example, will US public schools, currently responsible for sheltering, teaching, socializing, and certifying the preparedness of our children, continue to exist as a single institution?

One could argue that if K-12 or higher-education institutions in the US were meeting the market's needs in an effective and efficient manner, technological innovations in teaching and learning would never find a major niche here. However, the cost of higher education, indeed the cost of textbooks alone, have become national issues. There is open debate about the value of a college degree; vouchers to support alternatives to the public education system; homeschooling; and the decline of the high school diploma. A college degree is no longer a guarantee of upward social mobility, or even a job. And for-profit companies claim that they can do a better job than our public schools at just about any aspect of education — and do it cheaper. New teachers receive little training in what today's ed tech can do or how to use it.

Public discussions about the cost, effectiveness, relevance, and even the goal of education are commonplace and will in all likelihood influence research funding as well as the nature of the problems faced by schools, teachers, and learners — the problems researchers must address if their work is to realize its potential impact. Implications for cyberlearning are not limited to formal education (K-20+). Learning environments will no longer be defined solely as school-based. Innovations resulting from the emergence and application of new technologies to learning will influence the ways individuals of all ages learn as they live, attend schools, and work in the 21st century.

The purpose of education. Looking out 10 years, will we have the same percentage of high school students going to college? Will trade and professional education continue its growth? Will we adopt a more European model of limited, merit-based (test-based) advancement to secondary and postsecondary education? Will independent certification for specific job skills change the value of a high-school diploma? Will a high-school diploma mean anything to prospective employers? Will the lack of upward social mobility dramatically reduce demand for a college degree? Will life-long learning be a bigger factor in the global demand for education? Will countries decide that mandatory education could be completed by age 16 instead of 18, or that 18-year-olds need to know twice as much as we are teaching them today? The way

people approach these macro questions, and the policies that result, have a direct effect on the funding of research and, ultimately, on its relevance.

Rise of informal learning and independent certification. Where and how learners access information is not only changing our assumptions about how we define “learning environments,” it is also challenging formal educators in new ways. How will educators evaluate and leverage informal learning? How will they assess students’ prior out-of-school learning against prescribed curricula and make adjustments in order to reach/teach each student? How will educators recognize and build upon students’ independently acquired expertise to nurture their talents? How will formal learning be organized (e.g. flipped classrooms) to engage student’s informal learning skills/interests? Will the role of informal educators change? And if so, what types of new trainings/certifications might be needed of them? What new technologies/systems/practices will formal educators use to design, manage, assess and integrate students’ out-of-school learning into the formal education curriculum?

School infrastructure. Researchers should be aware that the classroom infrastructure is changing — Bring Your Own Device is just the beginning. It is hard to predict how the many general and education-specific technology trends will shape our research and the commercial impact of cyberlearning. One surprising possibility for cyberlearning researchers: historically, schools and classrooms had IT infrastructure that was years behind what we had in our labs. As schools, districts, and colleges build innovative solutions incorporating multiple advanced systems and products, researchers may find their lab’s IT infrastructure falling behind the schools they study. More of the research may have to be done in the field and in cooperation with commercial product vendors.

Online economics. Will schools and colleges routinely use online offerings to reduce labor costs and supplement their course catalogs in areas where qualified faculty are in short supply (e.g. computer programming or Chinese language)? Will online students be critical to the business models of all colleges, not just the for-profit institutions? How will residential programs differentiate themselves? In what ways will the online courses, independent certification, and other technological trends impact faculty staffing at the university and, in turn the demand for PhD’s to teach? How could a country without an effective literacy infrastructure, for example, find ways to educate their populations without building schools?

AI. Automated tutors and assistants are going to get [smarter and more human-like](#) — think bots that understand and use speech, gestures, facial expressions, etc. What kinds of tools will teachers need in

order to manage 20, or 200, students who each employ multiple AI's that in turn are scheduling, teaching, assessing, coaching, and advising them? Will smart products change the role of humans in the education process? How will today's public education systems manage this change?

Secure data sharing. Smart systems require data: data about the learner's objectives, preferences, and history, and data about the available resources (activities, assessment instruments, courses, ...) and their interdependencies. While student data privacy is a legitimate political issue, we must find a way for smart systems to securely share information about learners — not just grades, but their interests, preferences, activity streams, history, and details from the complex student models these systems build. Using data about the learner accumulated by other systems will be critical for the acceptance of AI-enhanced products like intelligent tutoring systems, personal learning assistants, adaptive drill and practice systems, learning games, smart books, and learning analytics engines.

Educational publishing and the marketplace. Who will mass produce the advanced learning activities envisioned by researchers using technologies like games, virtual reality, augmented reality, learning analytics, video, GPS, affect recognition, and AI? Will it be today's textbook publishers, game companies, tablet platform vendors, university professors, or a new category of provider? How will these offerings be sold to school districts and how will they be used in the classroom? How will administrators, teachers, parents, and learners discover, evaluate, acquire, use, review, and recommend the myriad of technology-based educational offerings? Will there be an Amazon for teachers?

There are surely many additional issues of great consequence to education and to research. Following these trends increases the likelihood that our research will remain relevant to the practice of education.

Resources

Some recommendations for keeping up with the various trends that will impact cyberlearning and related research. Please [contact CIRCL](#) if you have additional suggestions for ways to keep up with the trends that affect cyberlearning.

[Edsurge](#) is a great weekly newsletter for following ed tech trends, investments, and startups. Other publications that cover ed tech trends include:

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- [Inside Higher Ed](#)
- [Ed Tech Digest](#)
- [Hack Education](#)
- [Campus Technology](#)
- [The Journal](#)

The New Media Consortium's several [Annual NMC Horizon Reports](#) looks at emerging trends and technologies in K12, Higher Ed, Libraries, Museums and Schools.

Many conferences focus on emerging ed tech and its application in the various education and training market segments. The keynotes from these events are often made available on line. Worth mentioning are:

- [SXSWedu](#)
- [ASU-GSV Summit](#)
- [BETT Show, London](#)
- [DevLearn](#), focused on enterprise training technology
- [IITSEC](#), focused on military training technology

To track technology trends more generally:

- Look for annual review articles in tech publications like [ComputerWorld](#) and [Wired](#)
- Also, periodic reviews from industry analysts like [Deloitte](#) and [Gartner](#)
- [Computing Community Consortium](#)
- [The Internet Trends Report](#)

Trends in education, pedagogy, and classrooms:

- [Edutopia](#)
- [International Society for Technology in Education](#)
- [Association for Supervision and Curriculum Development](#)
- [The Center for Public Education](#)
- [UNESCO](#)
- [education.com](#)

Some recent reviews of Social and Demographic trends:

- [Pew Research Center](#)
- [The US Department of Labor](#)
- [The National Center for Educational Statistics](#) publishes multiple trends reports

Business trends in education and publishing:

- Michael Jay's monthly [Ed Table Talk](#) podcast often focuses on publishing issues
- The AAP's Annual [Content in Context Conference](#)
- The SIIA's [Education Technology Industry Network](#)
- [Publishing Trends](#)
- [University Business](#)
- [EducationDIVE](#)
- [District Administration](#)
- [EdWeek](#)
- [Independent Book Publishers Association](#)
- [GetElastic](#)

Readings

References and key readings documenting the thinking behind the concept, important milestones in the work, foundational examples to build from, and summaries along the way.

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